Modelling Salmonella transfer during grinding of meat

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Modelling *Salmonella* transfer during grinding of meat

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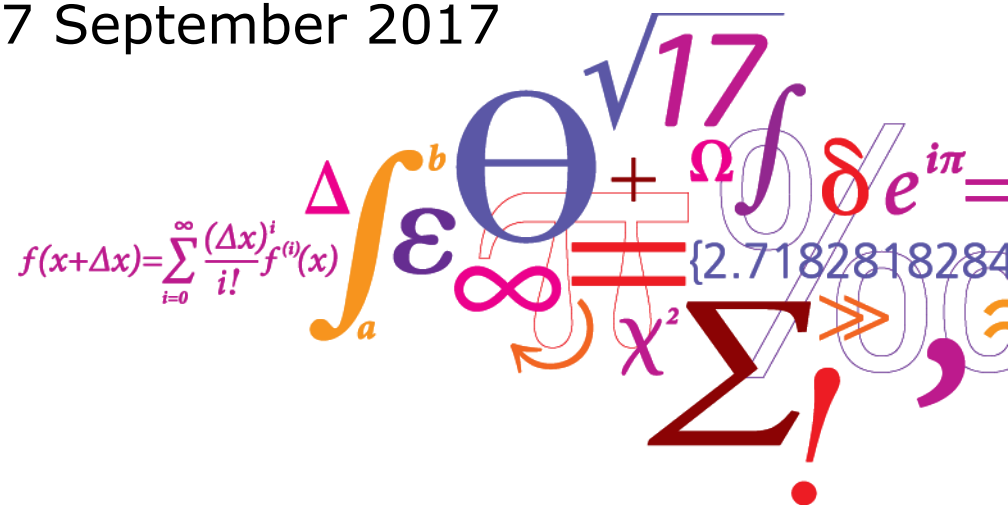

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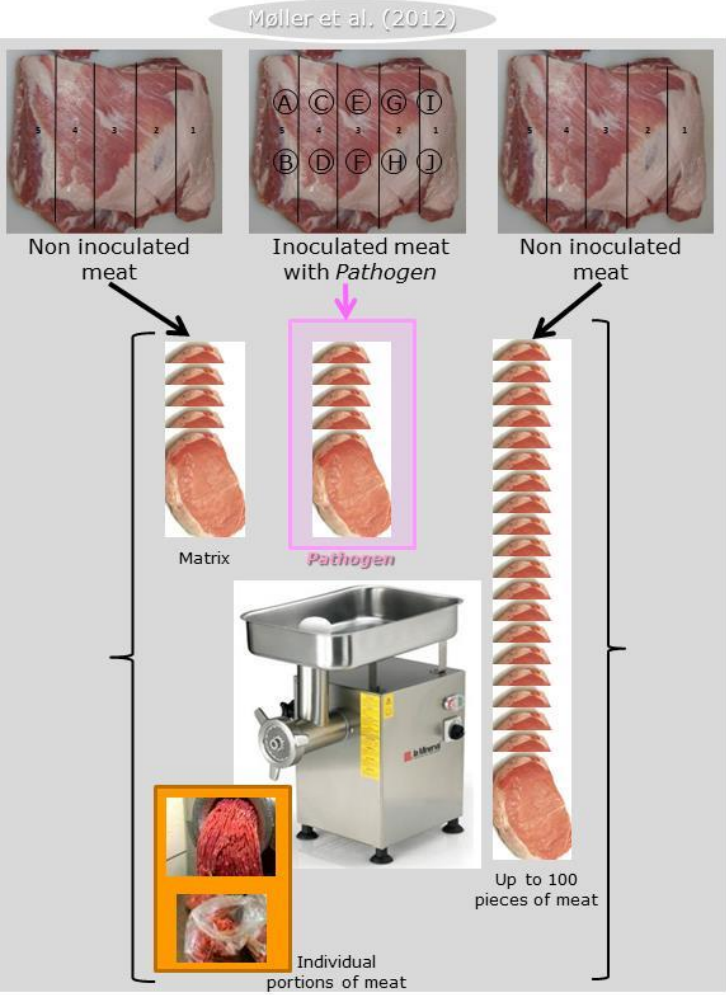
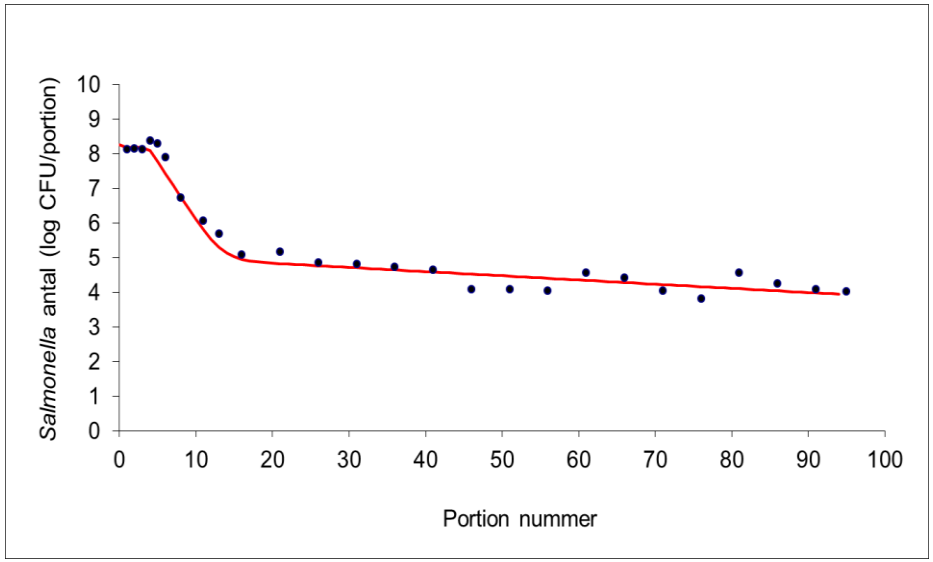
Background





$$
\begin{cases}
M_i = (1-a_1)(1-a_2)(1-c_2)\,P_i + (b_1\,gr_{1,i-1}) + (b_2\,gr_{2,i-1}) \\
gr_{1,i} = a_1\,P_i + (1-b_1)\,(1-c_1)\,gr_{1,i-1} \\
gr_{2,i} = a_2\,P_i + (1-b_2)\,(1-c_3)\,gr_{2,i-1}
\end{cases}
\qquad \textbf{Equation 1}
$$

a_1	b_1	a_2	b_2	$1 - c_3$
0.0010	0.0275	0.8909	0.0558	0.4887

Research question

Can this promising transfer model be successfully applied to any condition of meat grinding?

- For different types of meat?
- For different types of grinders?
- For variable sizes and numbers of meat pieces?

C.O.A. Møller [a,*], A.S. Sant'Ana [b,c], S.K.H. Hansen [a], M.J. Nauta [a], L.P. Silva [c], V.O. Alvarenga [b,c], D. Maffei [b], F.F.P. Silva [b], J.T. Lopes [b], B.D.G.M. Franco [b], S. Aabo [a], T.B. Hansen [a]

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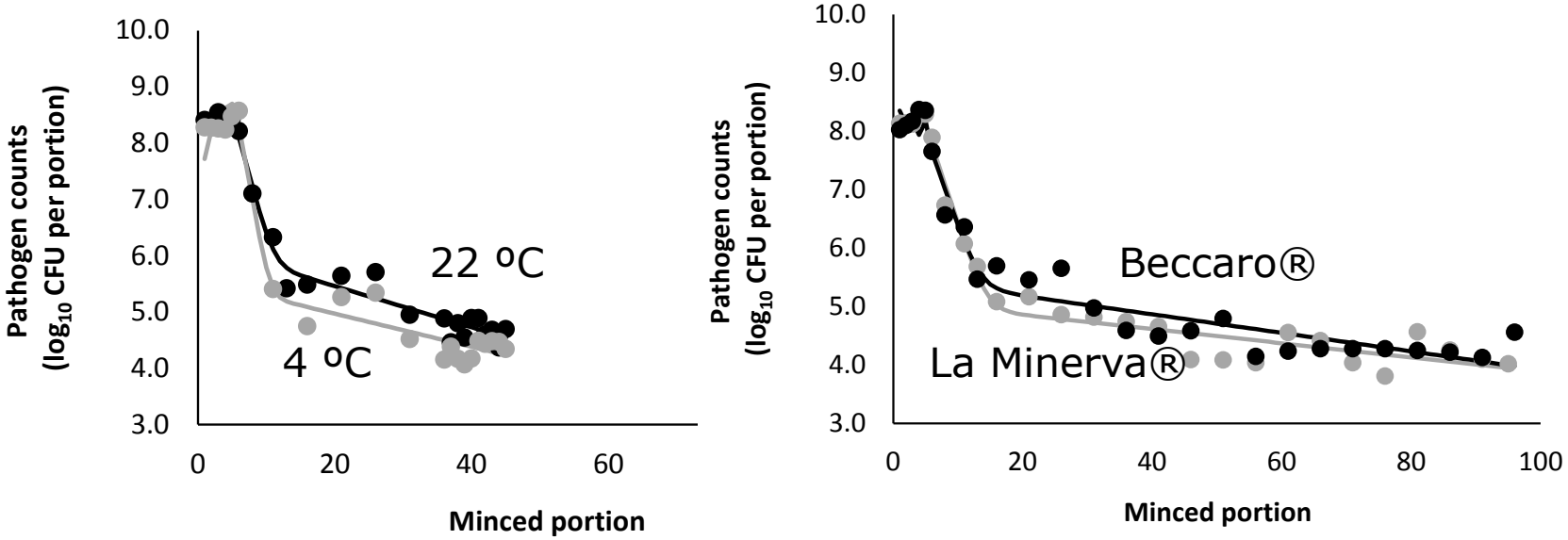
Data

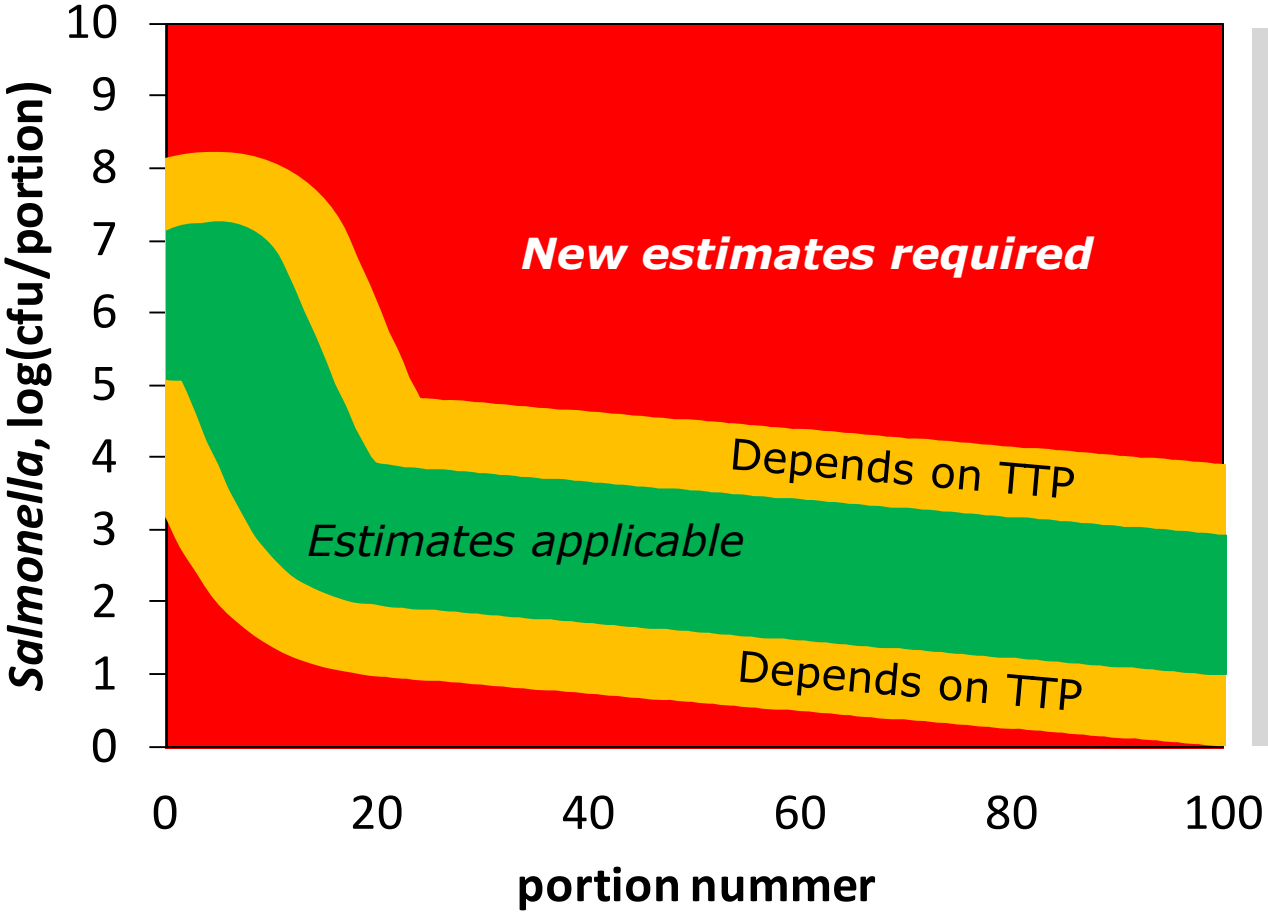
- 19 transfer trials
  - 11 from Brazil
  - 8 from Denmark, of which 3 were from Møller et al. (2012)
- Variables?
  - Grinder (Beccaro® and La Minerva®)
  - Number of meat pieces to be grinded (15 – 100)
  - Size of meat pieces (50 – 324 g)
  - Type of meat (pork and beef)
  - Temperatures (4 and 22 ºC)
- Evaluation?
  - Pairwise comparison

Evaluation criterion?



- Not only a statistical difference
- Also a practical difference
- A link between transfer dynamics and risk of salmonellosis
- QMRA model for meatballs by Møller et al. (2015)

A new stepwise ”risk-based” principle



1. Plot new obs.

2. ≥95% obs. in **green**: model OK

3. <95% obs. in **green**+**yellow**: NEW

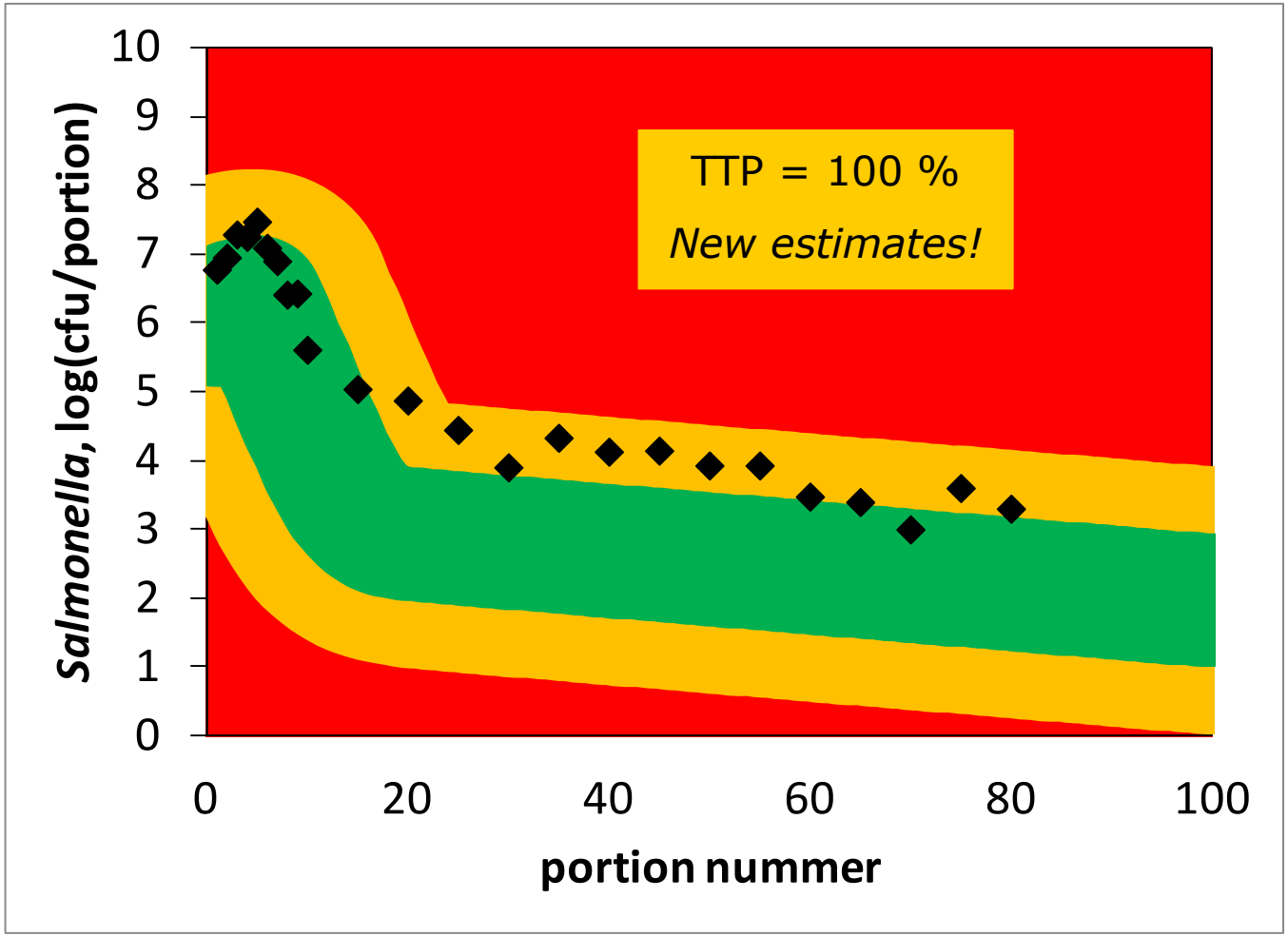
4. ≥95% obs. in **green**+**yellow**: calculate TTP

(Total Transfer Potential in %)

TTP > 50 %:

New estimates

Example using the new evaluation principle



Lessons learned

- 9 of 18 trials could ***NOT*** be described using parameter estimates from Møller et al. (2012)
  - Sharpness of grinder knife
  - Type of grinder
  - Sizes of meat pieces to be ground
  - Temperature

  } Influence the dynamics of transfer

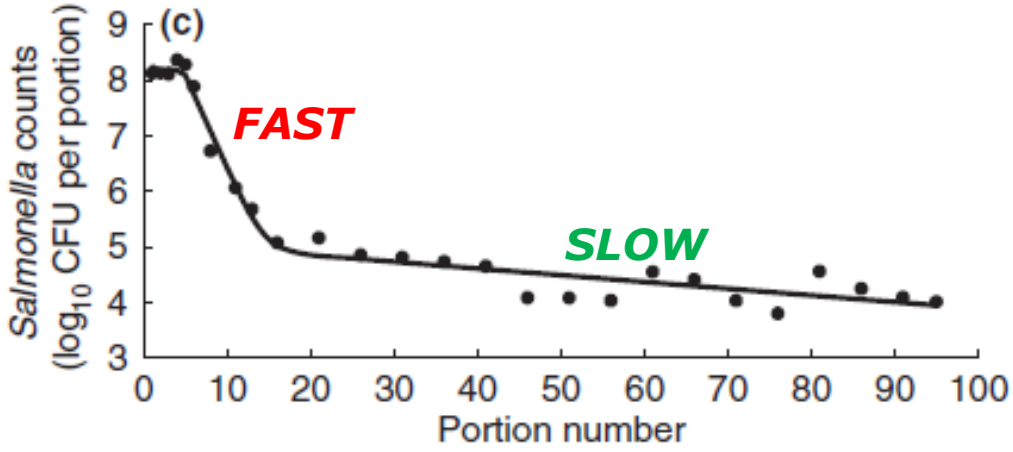
  - Number of meat pieces being ground

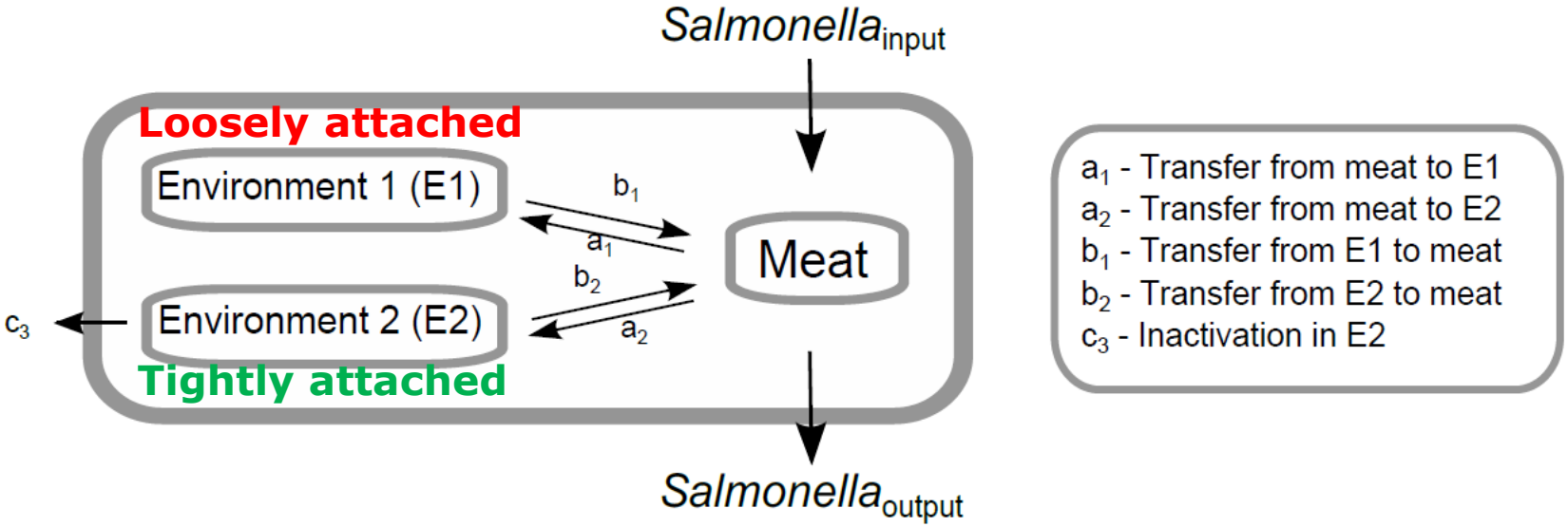
Relevant for parameter estimation

BUT - all trials were successfully described with the ***equation***

Hypothesis

- Transfer shows tailing phenomenon
- which can be explained assuming two "compartments" inside meat grinder

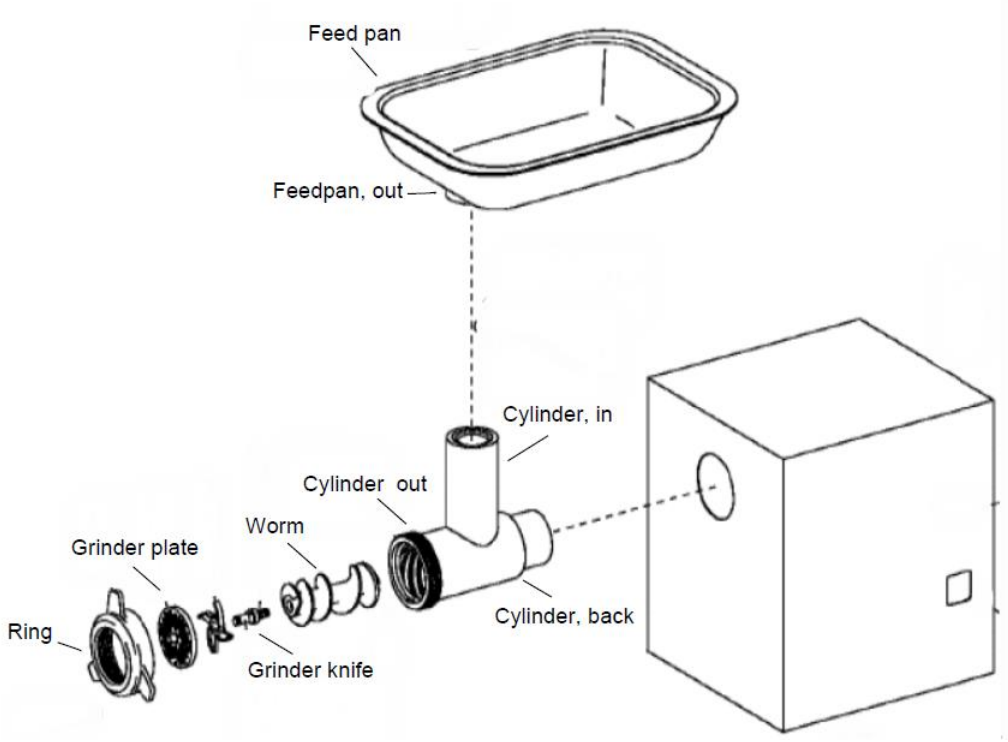




Aim

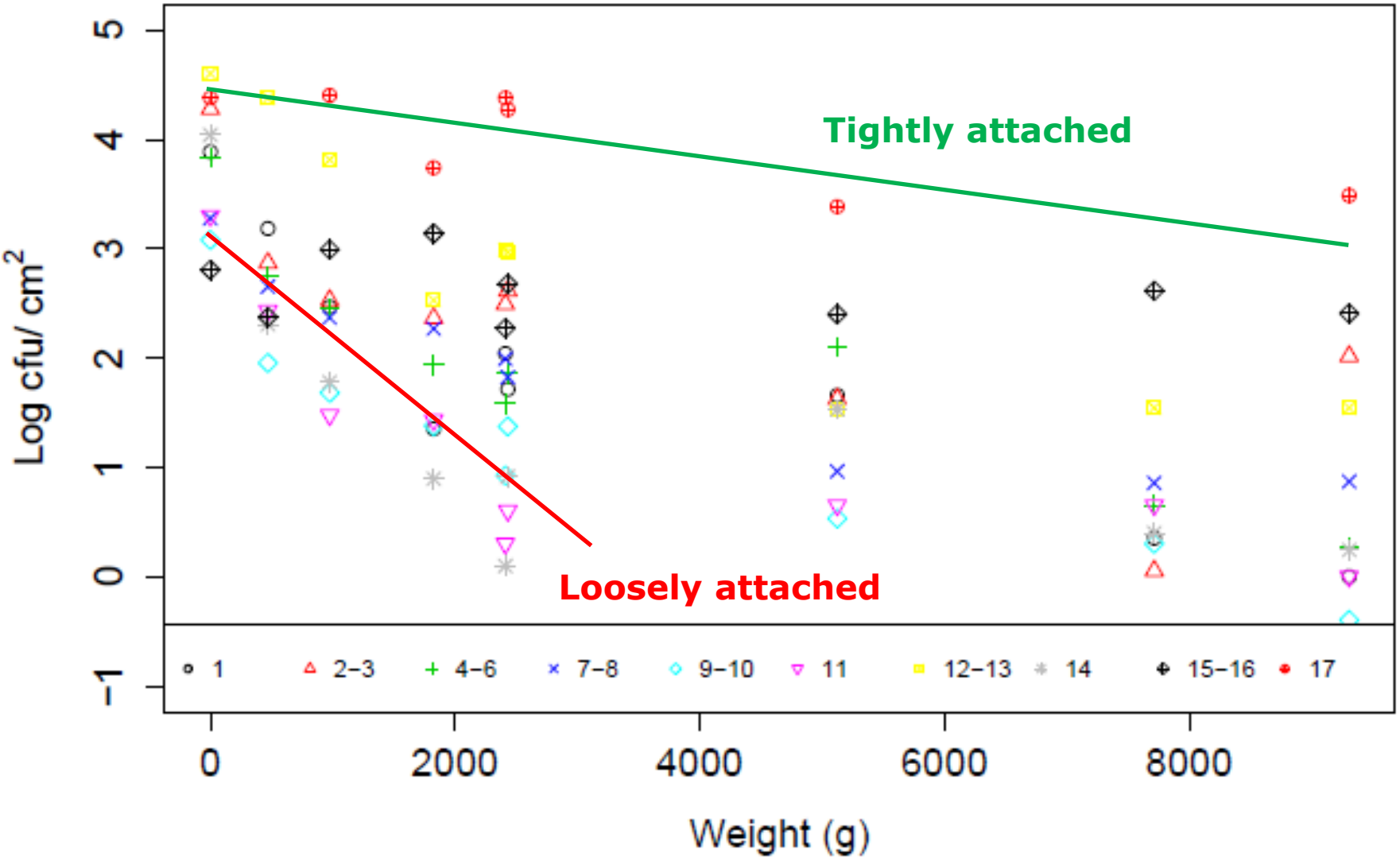
- To examine the meat grinder and attempt to identify loci with **loosely** or **tightly** attached *Salmonella*

- By investigating how many *Salmonella* we could recover (swabs) from 17 loci during grinding

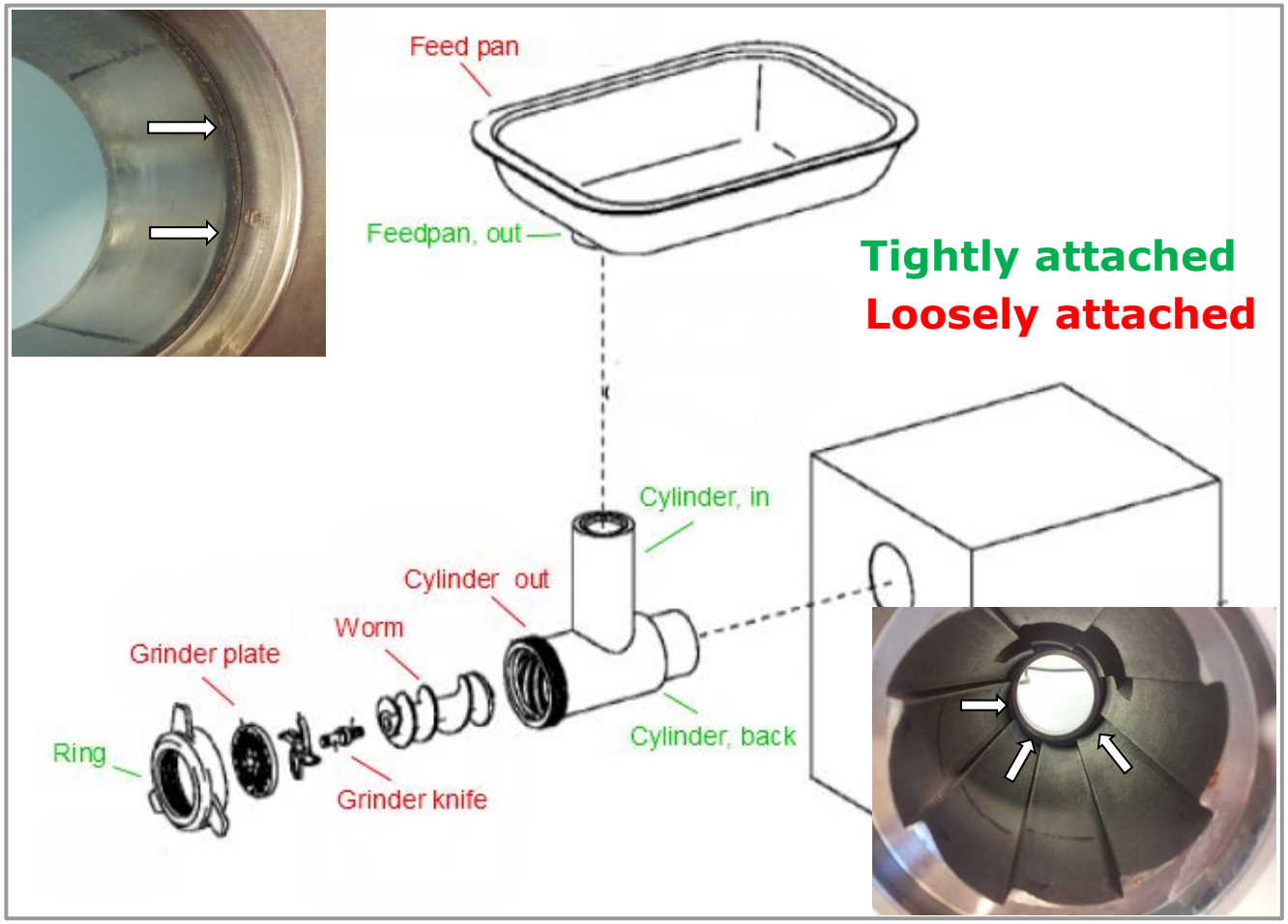


Master Thesis by
Solvej K.H. Hansen

Results – *Salmonella* in meat grinder



Physical structure responsible?



Conclusions

- The two ”compartments” most likely caused by physical structure
- *Salmonella* levels appear much lower than actual level
  - Irreversible adhesion?
  - Recovery method?